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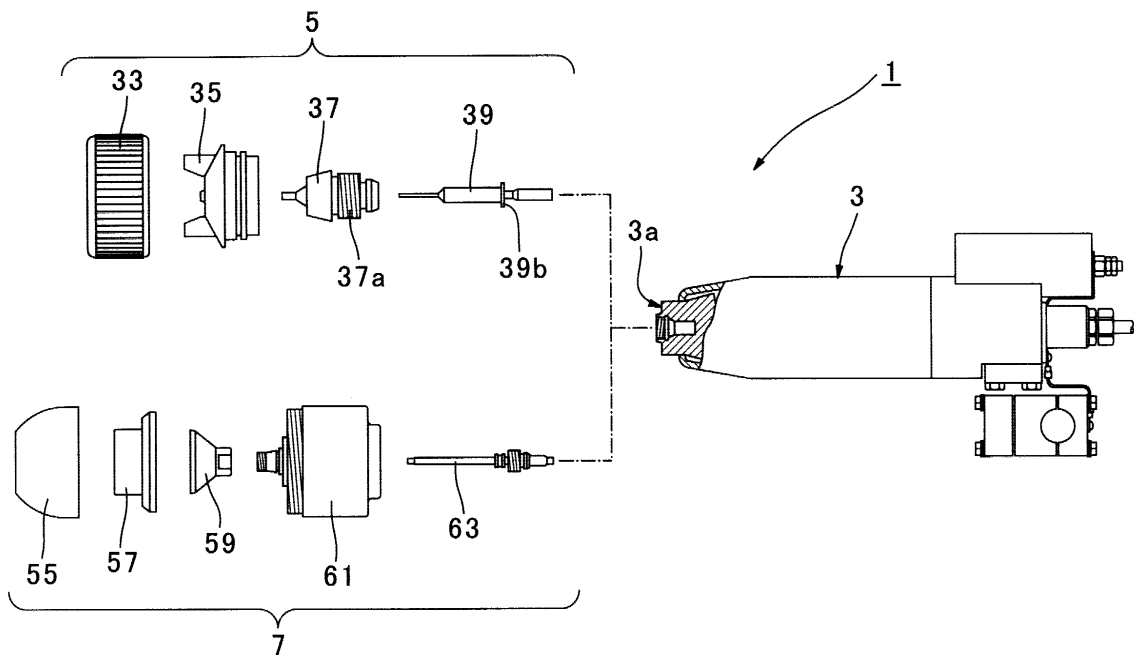
Electrostatic painting machine selectively used in two ways and a method for the same

(57)

An electrostatic painting machine is disclosed, which can selectively function in two ways of use, dedicated to the rotary atomizing painting and the aero-atomizing painting, respectively, by simply replacing a part of its components with another. An electrostatic painting machine (1) has a shared body (3), and an aero-atom-

izing head (5) and a rotary atomizing head (7) attachable to and detachable from the body (3). The painting machine (1) is dedicated to aero-atomizing painting when the aero-atomizing head (5) is attached to the body (3) while it is dedicated to the rotary atomizing painting when the rotary atomizing head (7) is attached to the body (3).

FIG. 1



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Description**FIELD OF THE INVENTION**

[0001] The present invention relates to an electrostatic painting machine, and more particularly, it relates to a painting machine that can serve as either an aero-atomizing painting machine or a rotary atomizing painting machine as required.

PRIOR ART

[0002] Electrostatic painting is a way of painting where paint is applied to a target object in an electrostatic condition, and a painting machine to carry out such electrostatic painting is classified into two types, i. e., rotary atomizing painting machines and aero-atomizing painting machines. The rotary atomizing painting machines inject paint which is transformed into fine particles by using corona discharged from an edge of a rotor such as a bell while the aero-atomizing painting machines inject paint which is atomized by using air as in a spray.

[0003] Although having a feature of enhanced (approximately 80 % or higher) painting efficiency, such a rotary atomizing painting machine is disadvantageous in that it can target only relatively flat objects. On the other hand, the aero-atomizing painting machine is poorer in the painting efficiency but is advantageous over the rotary atomizing painting machines in that, for instance, it can target objects, such as various boxes, of relatively great depth.

[0004] Due to such advantages and disadvantages, the rotary atomizing and aero-atomizing machines have been used depending upon types of paints and objects to be painted, as desired. Manufacturers of such painting machines have developed and sold in the markets those two types of painting machines, rotary atomizing painting machines and aero-atomizing painting machines, as being independent and separate from one another.

[0005] However, it costs users more that they have to obtain by themselves both the two types of dedicated painting machines, the rotary atomizing and aero-atomizing painting machines to separately use those machines for different use. It also costs the manufacturer more that they have to manufacture both the two types of painting machines separately and keep and manage stocks of parts of those machines individually.

[0006] Accordingly, it is an object of the present invention to provide a generic electrostatic painting machine that can selectively serve as a rotary atomizing painting machine and as an aero-atomizing painting machine by simply replacing a part of the machine with another, and also to provide a method for the same.

[0007] It is another object of the present invention to provide an electrostatic painting machine which shares common parts to the rotary atomizing painting machine

and the aero-atomizing painting machine.

SUMMARY OF THE INVENTION

5 [0008] In order to overcome the above-mentioned disadvantages of the prior art inventions, an electrostatic painting machine according to the present invention includes a shared body of a painting machine, and an aero-atomizing head and a rotary atomizing head both of which are attachable to and detachable from the painting machine, the painting machine serving as an aero-atomizing painting machine with the aero-atomizing head being attached to the body of the painting machine while the painting machine serves as a rotary atomizing painting machine with the rotary atomizing head being attached to the body of the painting machine.

10 [0009] A method for an electrostatic painting machine according to the present invention includes the steps of preparing a shared painting machine, preparing a replaceable aero-atomizing head that can be attached to a body of the painting machine, preparing a replaceable rotary atomizing head that can be attached to the body of the painting machine, selecting the aero-atomizing head or the rotary atomizing head as required, and attaching either one of the aero-atomizing head and rotary atomizing head that has been selected in the previous step, to the body of the painting machine. Thus, the present invention provides the method of selectively using the electrostatic painting machine in two ways for required uses, so that the present invention implements improvements mentioned as the objects of the invention.

15 [0010] These and other objects and advantages of the present invention will be more apparent from the following detailed description of the invention if taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

20 [0011] Fig. 1 is an exploded view showing electrostatic painting machine and a deployment of its parts;

[0012] Fig. 2 is a diagram showing the entire painting machine with an atomizing head attached thereto;

25 [0013] Fig. 3 is a partial sectional view illustrating a fore part of the painting machine in Fig. 2;

[0014] Fig. 4 is a diagram showing the entire painting machine with a rotary atomizing head attached thereto; and

30 [0015] Fig. 5 is a partial sectional view illustrating a fore part of the painting machine in Fig. 4.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

35 [0016] Preferred embodiments of the present invention will now be described with reference to the accompanying drawings.

[0017] Fig. 1 is an exploded view showing a deploy-

ment of primary components of a preferred embodiment of a painting machine to give a clear schematic depiction of the machine. A reference numeral 1 denotes an electrostatic painting machine, and the electrostatic painting machine is comprised of a gun 3 that is a main body of the painting machine, and first and second replaceable head assemblies 5 and 7 that can be selectively attached to a tip of the gun 3. The painting machine serves as an aero-atomizing painting machine with the first head assembly 5 being attached to the gun 3 while it serves as a rotary atomizing painting machine with the first head assembly 5 being replaced with the second head assembly 7. In other words, the electrostatic painting machine 1 has the shared gun 3 to which the first or second replaceable head assembly 5 or 7 is selectively attached, so that the single machine can be selectively used so as to dedicate itself as both the aero-atomizing painting machine and the rotary atomizing painting machine.

[0018] Fig. 2 is a schematic diagram illustrating the entire painting machine 1 with the first head assembly 5 being attached thereto for a use of the aero-atomizing painting machine while Fig. 3 is a sectional view showing a fore part of the painting machine extracted from Fig. 2. Fig. 4 is a schematic diagram illustrating the entire painting machine 1 with the second head assembly 7 being attached thereto for a use of the rotary atomizing painting machine while Fig. 5 is a sectional view showing a fore part of the painting machine extracted from Fig. 4. With reference to these drawings, the gun 3 or shared component will first be described below.

[0019] The gun 3 is substantially equivalent to those well-known in the art and used for the prior art aero-atomizing painting machines. The gun 3 has an elongated center hole 9 axially extending therein, and the elongated center hole 9 consists of a segment 13 having a relatively large diameter sufficient to enclose high-voltage cable 11 therein, a front opening 15 conducting to a fore end face 3a of the gun 3, and an intermediate segment 17 having a relatively small diameter and positioned between the front opening 15 and the cable enclosing segment 13, and all the three parts, the cable enclosing segment 13, the intermediate segment 17, and the front opening 15, are coaxially aligned with one another. The front opening 15 is conceptually divided into an elongated section 15a circular in cross section, a bell-shaped section 15b gradually spreading outward, and a cylindrical holder section 15c having its inner surface threaded, which are all contiguous in this order from the intermediate portion 17 toward the fore end face 3a of the gun 3.

[0020] The intermediate segment 17 of the elongated center hole 9 has its inner surface threaded so that a threaded socket 19 is screwed in it to connect with each other. The socket 19 is comprised of a cup 21 centered in its fore end face and circular in cross section, and an electrically conducting pin 23 extending between the bottom of the cup 21 and the high-voltage cable 11.

[0021] The gun 3 has its front portion provided with a first air port 25 opening to the fore end face 3a and a second air port 27 opening to the front opening 15 of the elongated center hole 9. More specifically, the second air port 27 has an opening at the boundary between the bell-shaped section 15b and threaded holder section 15c of the front opening 15. Pressurized air is supplied to the first and second air ports 25 and 27 via tubes 29 and 31, respectively, which are positioned inside the gun 3.

[0022] The gun 3 also has a paint introducing port (not shown) which opens to the front opening 15 of the elongated center hole 9. More specifically, the paint introducing port opens to an axially middle portion of the elongated section 15a in front opening 15, and liquid paint is supplied to the paint introducing port via a tube 32 (see Figs. 2 and 4) which is positioned in the gun 3.

[0023] Referring to Figs. 1 to 3 for details of the first head assembly or the aero-atomizing head assembly 5, the aero-atomizing head assembly 5 includes, similar to the prior art embodiments, components such as a retainer ring 33, an air nozzle 35, a paint nozzle 37, and a needle-shaped electrode 39.

[0024] To attach the aero-atomizing head assembly 5 to the gun 3, the needle-shaped electrode 39 is first inserted into the elongated center hole 9 of the gun 3, and thereafter, the rear end of the needle-shaped electrode 39 is fitted in the cup 21 of the socket 19. The needle-shaped electrode 39 has its rear end face axially formed with a dent 39a in which electrically conducting material such as a metal spring 41 rests. In this way, the rear end of the needle-shaped electrode 39 is fitted in the cup 21 of the socket 19, and thus, the needle-shaped electrode 39 is electrically connected to the high-voltage cable 11 via the electrically conductive spring 41 and the electrically conducting pin 23.

[0025] Then, a thread 37a machined in the outer peripheral surface of the paint nozzle 37 is screwed into the cylindrical holder section 15c of the elongated center hole 9 in the gun 3 to connect the paint nozzle 37 thereto. The needle-shaped electrode 39 may be introduced into the paint nozzle 37 so that the paint nozzle 37 along with the needle-shaped electrode 39 integrated therewith can be attached to the gun 3.

[0026] When the paint nozzle 37 is fully screwed down into the gun 3, a tapered portion shaped at the rear end of the paint nozzle 37 comes to rest on the bell-shaped section 15b in the elongated center hole 9 to tightly fit in and seal the bell-shaped section. The rear end face of the paint nozzle 37 is also engaged with a flange 39b formed in an intermediate portion of the needle-shaped electrode 39 to urge the needle-shaped electrode 39 backward with the flange 39b intervening between them, and this results in the rear end of the needle-shaped electrode 39 remaining securely fitted in the cup 21 of the socket 19. After that, the air nozzle 35 is attached onto the paint nozzle 37, and an inner circumferential thread 33a of the retainer ring 33 is screwed on

an outer circumferential thread 3b at the front end of the gun 3 to tightly couple the air nozzle 35 with the paint nozzle 37 by means of the retainer ring 33.

[0027] In this way, the aero-atomizing head assembly 5 attached to the gun 3 has its paint nozzle 37 defining an annular air passage 43 in the boundary between the bell-shaped section 15b and holder section 15c in the elongated center hole 9 of the gun 3 so as to be conductive to the second air port 27, and the annular air passage 4 is conductive through an atomizing air passage 45 in the paint nozzle 37 to an air chamber 47 which is defined by the fore end face of the paint nozzle 37 and the air nozzle 35, and the air chamber 47 leads to an annular gap defined by a small center aperture 35a in the air nozzle 35 and the needle-shaped electrode 39 extending through the aperture.

[0028] The aero-atomizing head assembly 5 has an annular air passage 49 defined by both the retainer ring 33 and the air nozzle 35 in a location leading to the first air port 25 in the gun 3, and the annular air passage 49 is conductive to a spray hole 35b in the air nozzle 35 via a pattern air passage 51 in the air nozzle 35.

[0029] As will be evaluated from the above description by a person having ordinary skills in the art, the passages linked in series to each other from the first air port 25 to the spray hole 35b in the air nozzle 35 make up the pattern air passage. The series of the passages extending from the second air port 27 to the small center aperture 35a (the annular gap around the needle-shaped electrode 39) together create the atomizing air passage, and the air nozzle 35 jets air out through its small center aperture 35a while atomizing paint that is being sprayed out of the paint introducing port through the paint nozzle 37, similar to the prior art embodiments. Such a feature of the painting machine 1 with the aero-atomizing head assembly 5 attached thereto is the same as that of the prior art dedicated aero-atomizing painting machine.

[0030] Referring to Figs. 1, 4, and 5 for details of the second head assembly or the rotary atomizing head assembly 7, the rotary atomizing head assembly 7 includes components such as an outer shaping ring 55, an inner shaping ring 57, a bell 59, an air motor 61, and a paint supply tube 63 of electrically conductive material such as metal.

[0031] As with the rotary atomizing head assembly 7, the components other than the paint supply tube 63 have been assembled together in advance to provide a preliminary assembly 65, and the head assembly 7 is attached to the gun 3 by first inserting the paint supply tube 63 into the elongated center hole 9 in the gun 3 and then screwing down a thread 63a machined on the rear portion of the paint supply tube 63 to fix the paint supply tube 63 to the cup 15c in the elongated center hole 9 in the gun 3.

[0032] Particularly, the paint supply tube 6 of the electrically conducting material has a fastener portion 63b of which outer surface is shaped corresponding to the intermediate section along its axial direction or the bell-

shaped section 15b and cylindrical holder section 15c of the front opening 15 located in the gun 3, and the outer circumferential thread 63a machined on the fastener portion 63b is screwed down in the cylindrical holder 15c to be engaged with a thread 3a, so that the paint supply tube 63 is fixed to the gun 3.

[0033] In this way, the rear end of the paint supply tube 63 is fitted in the cup 31 of the socket 19, similar to the needle-shaped electrode 39 of the aero-atomizing head assembly 5. The paint supply tube 63 has its rear end face formed with a dent 63c which is located along its axial extension to house an electrically conductive material, and the electrically conductive spring 41 rests in the dent 63c as in the first head assembly 5. Thus, such secure connection to the gun 3 by the paint supply tube 63 screwed down therein results in the rear end of the paint supply tube 63 resting deep in the cup 21 of the socket 19, and this causes the electrically conductive paint-supply tube 63 to be electrically connected to the high-voltage cable 11 via the electrically conductive spring 41 and the electrically conductive pin 23.

[0034] The preliminary assembly 65 has a thread 61a machined in a recessed section at its rear end face of the air motor 61, and the thread 61a is screwed down on an outer circumferential thread 3b at the tip of the gun 3 to fix the preliminary assembly 65 to the gun 3. The air motor 61 mentioned herein is of a type that employs a bearing having a ball bearing 61b, and alternatively, this may be replaced with any form of bearings well-known in the art.

[0035] The air motor 61 includes a motor body 67 and a cowling 69 surrounding it and made of electrically insulating plastic, and the bell 59 is attached to the tip of an output shaft 71 of the motor body 67. The output shaft 71 is comprised of metal hollow shaft, and the hollow output shaft 71 encloses the paint supply tube 63 coaxially and spaced apart from it. The rear end of the output shaft 71 slightly protrudes backward from the motor body 67, and such a protruding portion 71a has its outer circumferential surface threaded and screwed in a spacer 73 which functions to retain the output shaft 71 in position relative to the paint supply tube 63. The spacer 73 is made of conductive metal, and the paint supply tube 63 and the conductive output shaft 71 are electrically connected to each other via the metal component. By virtue of such connection, there is provided an electrical path leading from the high-voltage cable 11 through the conductive pin 23, the conductive spring 41, the paint supply tube 63, the spacer 73 and the output shaft 71 to the bell 59, creating electrostatic field between a front edge of the bell 59 and an object to be painted.

[0036] The plastic cowling 69 for the air motor 61 is provided with a first inner path 75 leading to the first air port 25 and a second inner path 77 leading to the motor body 67. The first inner path 75 has an annular inlet 75a located at an interface with an outlet of the first air port 25 and an annular outlet 75b opening to a shaping path 79 defined by both the outer shaping ring 55 and the

inner shaping ring 57.

[0037] Similarly, the second inner path 77 has an annular inlet 77a located adjacent to the fastener portion 63b of the paint supply tube 63. A plurality of through-holes 63d are formed, extending axially in the outer circumference of the fastener portion 63b of the paint supply tube 63, and the plurality of the through-holes 63d are spaced from one another. The through-holes 63d in the fastener portion 63a and the annular inlet 77a are capable of ensuring a communication of the second air port 27 with the second inner path 77.

[0038] It would be evaluated from the above description by any person skilled in the art that a continuous passage leading from the first air port 25 through the first inner path 75 to the shaping path 79 serves as a shaping path through which pressurized air flows till it is blown out thorough a gap defined at the front end between the outer shaping ring 55 and the inner shaping ring 57. Also, pressurized air introduced into the second inner path 77 from the second air port 27 actuates the air motor 61 to cause the bell 59 to rotate at high velocity.

[0039] As has been recognized from the above, the exemplary painting machine 1 has a shared gun 3 to which the first head assembly 5 or the second head assembly 7 is selectively attached, and thus, the painting machine 1 can be used in two ways of use as the aero-atomizing painting machine and the rotary atomizing painting machine. More specifically, the exemplary painting machine 1 incorporates full features and performances of the prior art aero-atomizing painting machines along with the second head assembly 7 so that it can function just as the rotary atomizing painting machine. Additionally, when used as the rotary atomizing painting machine, the exemplary painting machine 1 is energized to supply electric power to the bell 59 by means of the high-voltage cable 1 via the paint supply tube 63 and the spacer 73.

[0040] Although the preferred embodiments of the present inventions have been described, the invention should not be limited to them but should include modifications and variations stated as follows:

(1) Although the above-mentioned embodiments which work primarily as the aero-atomizing painting machine can be combined with the second head assembly or the rotary atomizing head assembly 7 to attach to the gun 3, alternatively a modification of a reversed concept may be designed in which the painting machine 1 which works primarily as the rotary atomizing painting machine can be combined with the first head assembly or the aero-atomizing head assembly 5 to attach to the bell, so as to function as the aero-atomizing painting machine.

(2) In the above-mentioned embodiments, the first air port 25 which is a part of the pattern air passage is utilized to supply the aero-atomizing painting machine with the shaping air for a use of the rotary atomizing painting while the second air port 27 is utilized to supply the same with the motor driving air for a use of the rotary atomizing painting. A variation of a reversed concept may be alternatively implemented in which the first air port 25 is utilized to supply the aero-atomizing painting machine with the motor driving air for the rotary atomizing painting while the second air port 27 which is a part of the atomizing air passage is utilized to supply the same with the shaping air for the rotary atomizing painting.

(3) Although, in the above-mentioned embodiments, air and paint are delivered through the gun 3 to the aero-atomizing head assembly 5 and the rotary atomizing head assembly 7, respectively, the air and paint may be supplied directly to the aero-atomizing head assembly 5 and the rotary atomizing head assembly 7 without an intervening component such as the gun 3.

(4) Although examples of the painting machine spraying liquid paint have been described, the present invention can apply to embodiments that would be used to spray powder paint.

(5) Although, in the above-mentioned embodiments, the aero-atomizing head assembly 5 and the rotary atomizing head assembly 7 are attached directly to the gun 3, respectively, an attachment may be first fixed to the gun 3 so that the aero-atomizing head and the rotary atomizing head can be fixed to the attachment in a single and simple attaching action.

(6) In a variation similar to the modification (5) where the aero-atomizing head and the rotary atomizing head are fixed to the gun with the attachment intervening between them, a swing mechanism may be incorporated in the attachment so that the aero-atomizing head and the rotary atomizing head can pivot.

Claims

1. An electrostatic painting machine which can selectively function in two ways of use, comprising,

a shared body of the painting machine,
replaceable aero-atomizing and rotary atomizing heads attachable to and detachable from the body, and

the painting machine being dedicated to aero-atomizing painting with the aero-atomizing head being attached to the body of the painting machine, and

the painting machine being dedicated to rotary atomizing painting with the rotary atomizing head being attached to the body of the painting machine.

2. An electrostatic painting machine according to

claim 1, wherein the body of the painting machine has a hole opening in a fore end face of the body, high-voltage cable and a socket electrically connected to the high-voltage cable being located in the hole,

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the socket has a recessed portion which cups a rear end of a needle-shaped electrode or a component of the aero-atomizing head and a rear end of a paint supply tube or a component of the rotary atomizing head, and the paint supply tube is made of conductive material, and the paint supply tube is used to supply a bell or a component of the rotary atomizing head with electricity.

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3. An electrostatic painting machine according to claim 2, wherein when the aero-atomizing head is attached to the body of the painting machine, pattern air and atomizing air for the aero-atomizing head are supplied through first and second air passages located within the body of the painting machine, and

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when the rotary atomizing head is attached to the body of the painting machine, shaping air and motor driving air for the rotary atomizing head are supplied through the first and second air passages located within the body of the painting machine.

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4. A method for selectively using an electrostatic painting machine in two ways, including the steps of

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preparing a shared body of a painting machine, preparing a replaceable aero-atomizing head that can be attached to the body of the painting machine, preparing a replaceable rotary atomizing head that can be attached to the body of the painting machine, selecting the aero-atomizing head or the rotary atomizing head as required, and attaching either one of the aero-atomizing head and the rotary atomizing head that has been selected in the step of selecting the atomizing head, to the body of the painting machine.

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FIG. 1

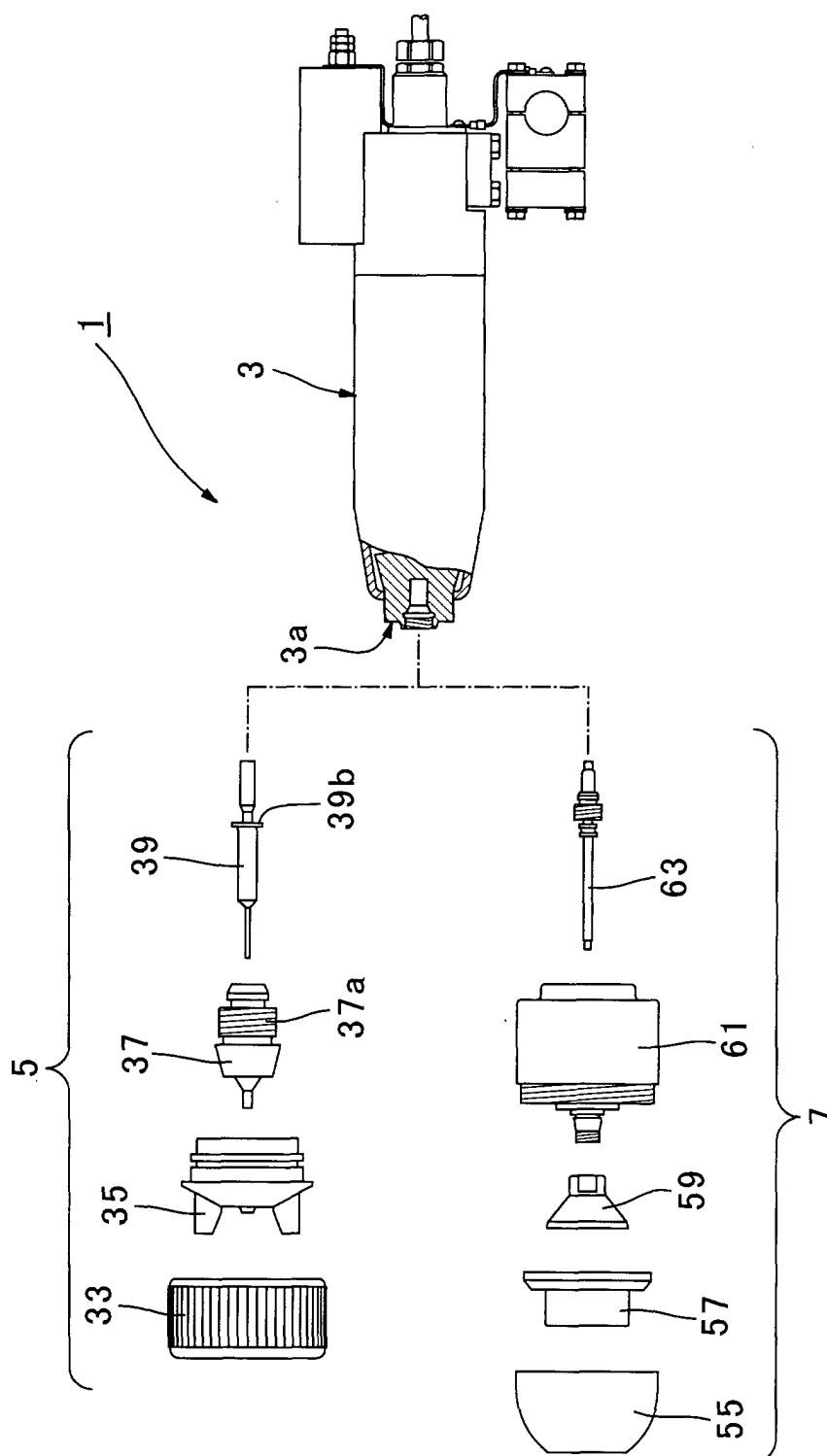


FIG. 2

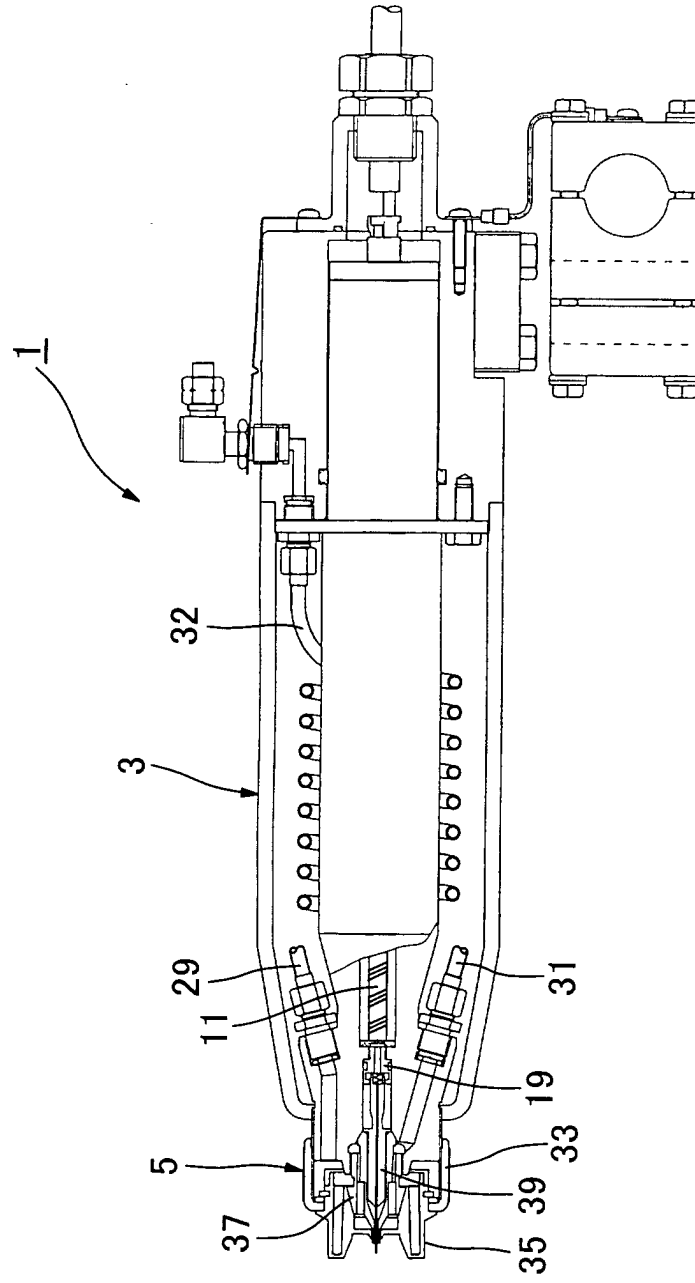


FIG. 3

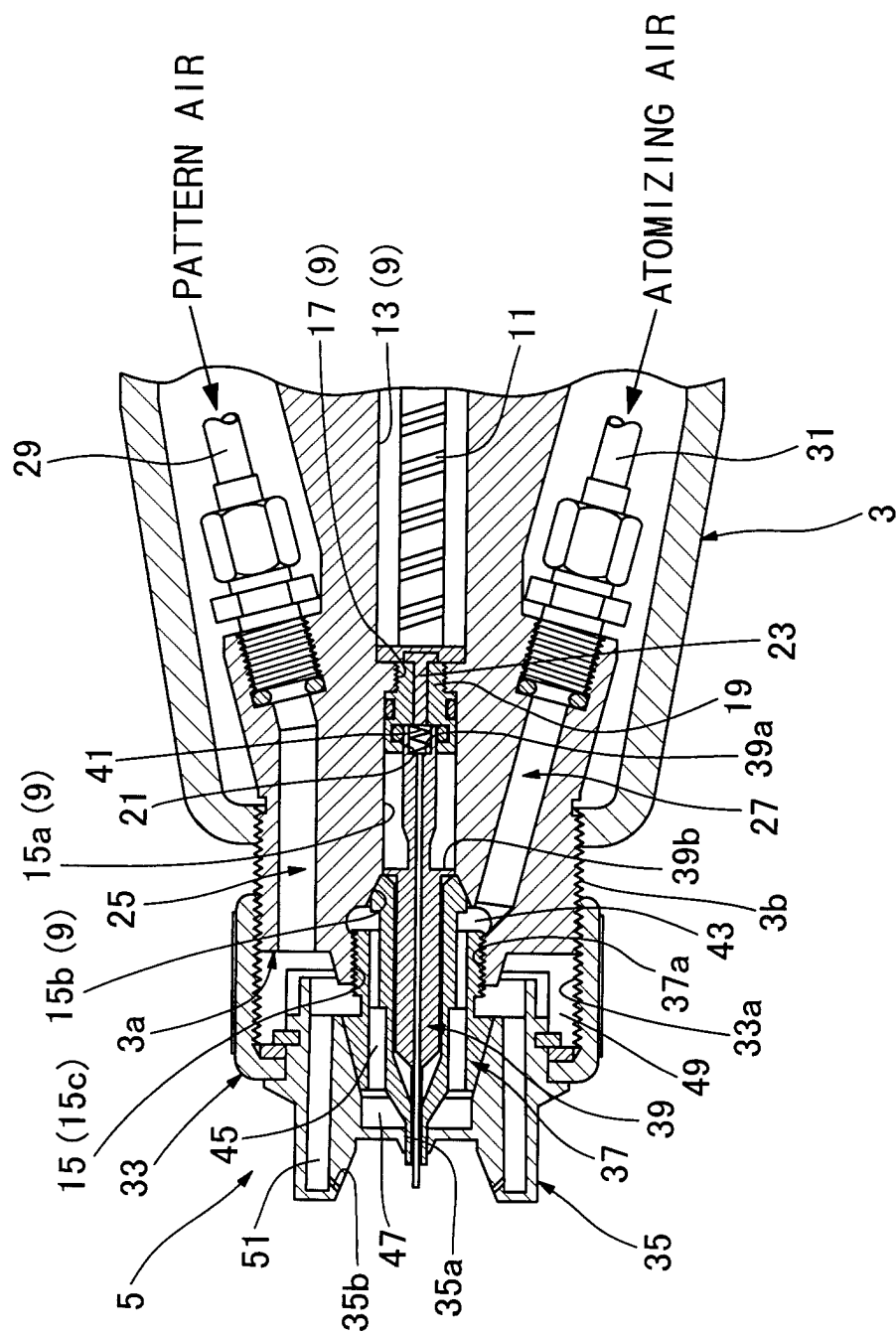


FIG. 4

